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Renewables Portfolio Standards: A Factual Introduction to Experience from the United States

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I. Introduction

Renewables portfolio standards (RPS) have – since the late 1990s – proliferated at the state level in the United States. What began as a policy idea minted in California and first described in detail in the pages of the *Electricity Journal*¹ has emerged as an important driver for renewable energy capacity additions in the United States. Over the years, articles in the *Electricity Journal* have explored the RPS in more detail, identifying both its strengths and weaknesses.²

The present article provides an introduction to the history, concept, and design of the RPS, reviews early experience with the policy as applied at the state level, and provides a brief overview of Federal RPS proposals to date and the possible relationship between Federal and state RPS policies. Our purpose is to offer a factual introduction to the RPS, as applied and considered in the U.S. Though elements of state RPS design are summarized here, other publications provide a more thorough review of design lessons that emerge from that experience.³ In addition, the present article does not describe the results of economic analyses of Federal RPS proposals, though we do cite many of the analyses conducted by the U.S. DOE's Energy Information Administration (EIA).

II. History and Current Application

The design of an RPS may vary, but at its heart an RPS requires electricity suppliers (or, alternatively, electricity generators or consumers) to source a certain quantity (in percentage, megawatt-hour, or megawatt terms) of renewable energy. Many – but not all – such policies include the trading of renewable energy certificates.

Discussions of the detailed design of an RPS first began in California in 1995.⁴ Though California chose not to implement an RPS at that time (California later did so, in 2002), the clean

¹ Rader, Nancy, and Richard Norgaard. "Efficiency and Sustainability in Restructured Electric Markets: The Renewables Portfolio Standard." *The Electricity Journal*, July 1996.

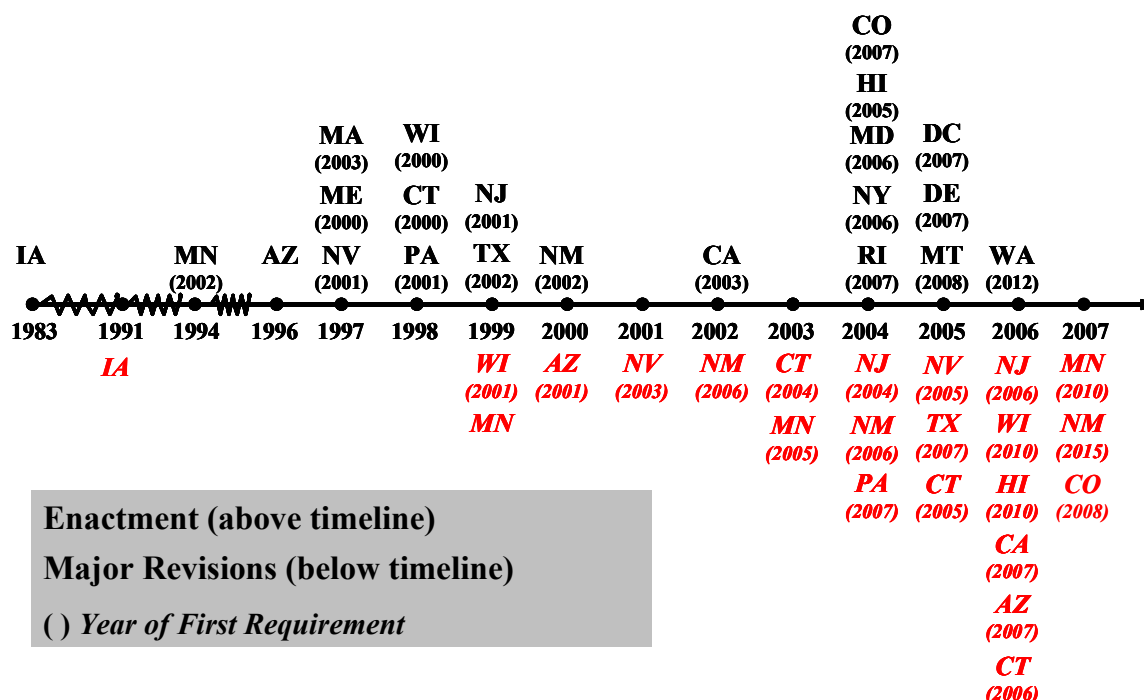
² See: (1) Bernow, Steve, William Dougherty, and Max Duckworth. "Can We Afford a Renewables Portfolio Standard?" *The Electricity Journal*, May 1997. (2) Haddad, Brent, and Paul Jefferiss. "Forging Consensus on National Renewables Policy: The Renewables Portfolio Standard and the National Public Benefits Trust Fund." *The Electricity Journal*, March 1999. (3) Wiser, Ryan, Kevin Porter, and Steve Clemmer. "Emerging Markets for Renewable Energy: The Role of State Policies during Restructuring." *The Electricity Journal*, January/February 2000. (4) Chupka, Marc. "Designing Effective Renewable Markets." *The Electricity Journal*, May 2003. (5) Wiser, Ryan, Kevin Porter, Mark Bolinger, and Heather Raitt. "Does It Have To Be This Hard? Implementing the Nation's Most Complex Renewables Portfolio Standard." *The Electricity Journal*, October 2005. (6) Ferrey, Steven. "Renewable Orphans: Adopting Legal Renewable Standards at the State Level." *The Electricity Journal*, March 2006. (7) Berendt, Christopher. "A State-Based Approach to Building a Liquid National Market for Renewable Energy Certificates: the REC-EX Model." *The Electricity Journal*, June 2006. (8) Sovacool, Benjamin, and Christopher Cooper. "Green Means 'Go' – A Colorful Approach to a U.S. National Renewable Portfolio Standard." *The Electricity Journal*, August/September 2006.

³ See, e.g., Ryan, Kevin Porter, and Robert Grace. "Evaluating Experience with Renewables Portfolio Standards in the United States." LBNL-54439, March 2004. <http://eetd.lbl.gov/ea/ems/reports/54439.pdf>.

⁴ See: (1) Gregg Morris, Ryan Wiser, and Steven Pickle, eds. "Renewables Working Group to the California Public Utilities Commission." CPUC No. 500-96-008, August 1996. (2) Wiser, Ryan, Steven Pickle, and Charles Goldman. "Renewable Energy Policy and Electricity Restructuring: A California Case Study." *Energy Policy*, September 1998. RPS policies in Minnesota and Iowa predated the discussions in California, but these two renewable energy mandates were only later labeled as RPS policies.

energy advocacy community quickly picked up the concept. Initially, state RPS policies were generally incorporated into much broader state electricity restructuring legislation. More recently, however, state RPS policies have been adopted through stand-alone legislation. The RPS is sometimes viewed by policy-makers as a “market-friendly” way of ensuring that a minimum amount of renewable energy deployment will be achieved, and is a widely used policy (relative to other renewable energy policy mechanisms) in part because an RPS does not typically require an explicit allocation of governmental funding. Though most state RPS policies have been enacted through legislation, two have been established through regulatory channels (Arizona and New York) and two through voter-approved initiatives (Colorado and Washington).⁵

Figure 1 shows the rate of state RPS adoption over time, presenting both the year of initial enactment and the years in which major changes to state RPS policies have been made. Where changes have been made, with few exceptions, these legislative changes have been to strengthen RPS requirements; no state RPS policy has yet been repealed by later legislative action. Today, 21 states and the District of Columbia have mandatory RPS obligations (Figure 2). These policies cover roughly 40% of total U.S. electrical load, and have been implemented in both restructured electricity markets and in cost-of-service-regulated markets. In addition to these mandatory policies, voluntary renewable energy standards exist in Iowa, Illinois, Vermont, and Maine.⁶

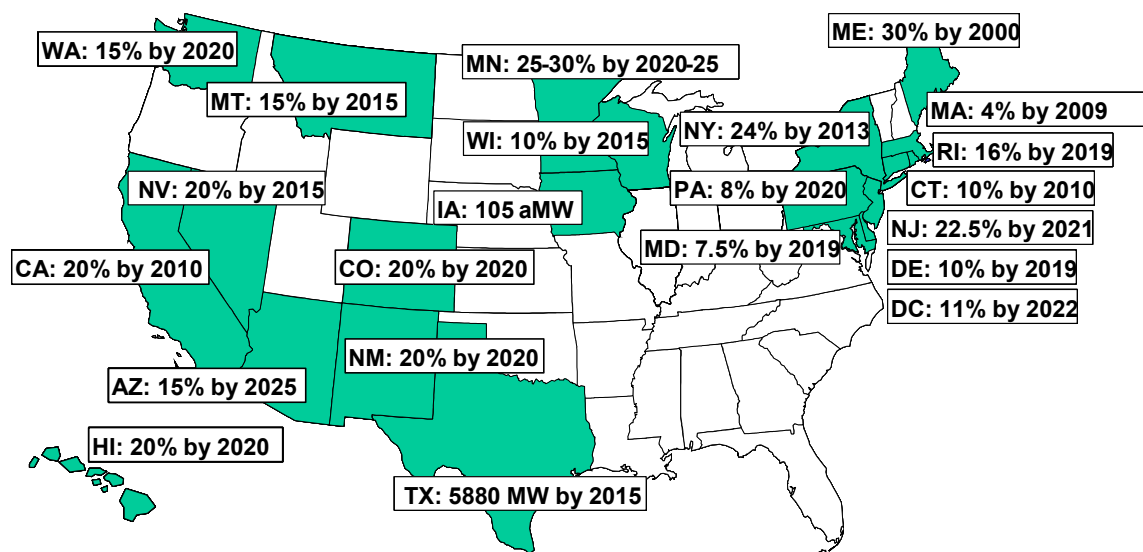


Source: Union of Concerned Scientists; revised by Berkeley Lab

Figure 1. The Adoption and Revision of State RPS Policies

⁵ The Colorado RPS initially passed based on a voter initiative in 2004, with 53% support. The Washington state RPS passed in 2006 with 52% of the vote. In both cases, relatively narrow majorities supported the state RPS.

⁶ Maine’s RPS contains both a mandatory and voluntary component.



Source: Lawrence Berkeley National Laboratory

Figure 2. State RPS Policies (March 2007)

The RPS is not solely a U.S. phenomenon. Similar policies, variously called Quotas, Renewables Obligations, or Tradeable Green Certificate programs, now exist in – at a minimum – the United Kingdom, Sweden, Belgium, Italy, Poland, Japan, and Australia. Most of these policies have been established since 2000, so experience is scant. Though detailed information on these policies is not offered in the pages that follow, early international experience matches (to some degree) that in the U.S. in that a variety of RPS designs are in place, and experience with those designs has been mixed, with some policies resulting in relatively high-cost renewable energy additions and/or limited impacts on the renewable energy marketplace.⁷

III. The Mechanics and Design of an RPS

For the purpose of this article, we define an RPS as a requirement that retail electricity suppliers procure a certain minimum quantity of eligible renewable energy or capacity, measured in either absolute units (kWh or kW) or as a percentage share of retail sales. RPS policies are generally designed to maintain and/or increase the contribution of renewable energy to the electricity supply mix. The RPS establishes numeric targets for renewable energy supply, applies those targets to retail electricity suppliers, and seeks to encourage competition among renewable developers to meet the targets in a least-cost fashion. RPS purchase obligations generally increase over time, and retail suppliers typically must demonstrate compliance on an annual basis. These requirements are often backed with some form of penalty if compliance is not achieved.

Many RPS programs utilize tradable renewable energy certificates (RECs) to increase the flexibility and reduce the cost of compliance with the purchase mandate, and to facilitate

⁷ See, for example, van der Linden, Nico, et al. “Review of International Experience with Renewable Energy Obligation Support Mechanisms.” ECN-C—05-025, May 2005. <http://eetd.lbl.gov/ea/ems/reports/57666.pdf>.

compliance tracking. A REC is created when a megawatt-hour of renewable energy is generated, is a purely financial product, and can be traded separately from the underlying electricity generation. REC transactions create a supplemental revenue stream for renewable generators, and allow retail suppliers to demonstrate compliance with the RPS by purchasing RECs in lieu of directly purchasing renewable electricity.

Though the concept appears simple and direct in theory, in practice, RPS designs vary substantially from one another; so much so, that there is some debate over what exactly constitutes an RPS, and whether certain states qualify as having an RPS. Illinois, for example, has established voluntary renewable energy targets; New York has established a policy that it calls an RPS, but that involves ratepayer collection of funds and incentive payments from a state energy authority. Above we have identified New York as a state with an RPS, and Illinois as one without such a policy: we readily acknowledge that such classifications are subject to debate.

A subset of the numerous types of policy variations possible in RPS program design are listed in Table 1.

Table 1. RPS Policy Design Options

Structure, Size, and Application	Eligibility	Administration
<ul style="list-style-type: none"> • Basis (energy vs. capacity obligation) • Purchase obligations over time • Structure (single tier or multiple tiers) • Resource diversity requirements or incentives • Start date • Duration of obligation (sunset provisions) • Application to retail suppliers, and exemptions from obligation • Product- or company-based application 	<ul style="list-style-type: none"> • Geographic eligibility • Resource eligibility • Eligibility of existing renewable generation • Definition of new/incremental generation • Treatment of multi-fuel facilities • Treatment of off-grid and customer-sited facilities 	<ul style="list-style-type: none"> • Regulatory oversight body(ies) • Compliance verification (RECs, or otherwise) • Certification of eligible generators • Compliance filing requirements • Enforcement mechanisms • Cost caps and alternative compliance payments • Flexibility mechanisms (banking, borrowing, etc.) • Contracting standards for regulated retail suppliers • Cost recovery for regulated retail suppliers • Interactions with other energy and environmental policies

Source: Lawrence Berkeley National Laboratory

Structure, Size, and Application

RPS policies may vary significantly in basic program structure, size, and application. Perhaps the most common targets establish a periodic (often annual) schedule that specifies the share of electricity sales that must be accounted for by eligible renewable resources. In other cases, targets might be based on absolute generation or installed capacity. Some policies or proposals contain a “sunset” date, after which the requirement is assumed to expire. “Tiered” targets establish different resource-eligibility requirements for two or more sets of renewable energy

purchase targets, frequently with different schedules and compliance frameworks.⁸ Tiers are often used to ensure that an RPS provides support to not just the least-cost renewable energy options, but also to certain “preferred” resources such as solar power. For a variety of reasons, RPS policies sometimes provide exemptions for certain suppliers, often including municipal utilities and rural electric co-operatives; still other policies might exempt certain customers from meeting RPS obligations.

Eligibility

Although the generic term “renewable” is used to describe RPS policies, there is not universal agreement about eligible resources. Wind, solar, geothermal, landfill-gas, and ocean-based energy resources are typically eligible to meet RPS obligations in jurisdictions where such resources are available. There is often less agreement, however, on the eligibility of biomass, municipal solid waste (MSW) incineration, and hydro-electric resources. Qualified biomass or MSW is sometimes limited to certain technologies and fuel types, for example, while hydropower may be subject to qualification based on facility size, age, or design (such as run-of-river or storage projects). Some policies may allow select non-renewable generation to meet a portion of policy targets, or even allow non-generation actions – such as energy efficiency programs – to earn credit toward meeting the target. Whether existing renewable sources are eligible to meet RPS obligations may also vary, as might the geographic location of eligible generators and the requirements of those generators to deliver electricity locally.

Administration

Though RPS requirements typically apply to retail electricity suppliers,⁹ they can have varying degrees of flexibility in how a given company can acquire renewable generation. REC trading is commonly allowed, and banking and borrowing of RECs may be accepted. RECs may often be purchased through long-term contracts, shorter-term contracts, or through spot purchases, and some RPS policies provide oversight of utility compliance and contracting decisions. Cost-of-service regulated utilities are expected to recover any excess costs through standard rate-making proceedings. Where retail competition is allowed, cost-recovery is somewhat less certain, but any excess costs are likely to be passed on to electricity consumers. In some jurisdictions, the government absorbs some or all of the excess costs, sometimes from dedicated funds derived from a surcharge on electricity service. Cost caps of various types are often employed to ensure limits to the cost of RPS compliance. There is a wide variety of mechanisms that can be used to enforce RPS requirements, such as electricity license revocation or civil fines. In addition, RPS policies might allow for compliance without actual renewable generation through provisions such as alternative compliance payments, statutory waivers, and discretionary waivers.

⁸ In some cases, excess compliance toward the policy-preferred tier may be used to satisfy secondary tier requirements, but compliance from the secondary tier is not generally allowed to satisfy compliance in the policy-preferred tier.

⁹ Also referred to as “load serving entities,” “regulated utilities,” “electricity retailers,” “electricity service providers,” or other terms referring to the entity responsible for end-use electricity sales

IV. State RPS Experience and Expectations

A. Policy Design and Early Experience

RPS policies share the common goal of encouraging renewable energy supply, but there are many variations in the scope, nature, and design of existing state RPS requirements, reflecting the diversity of design choices discussed earlier. The tailoring of RPS designs to satisfy particular state objectives and political exigencies is a typical aspect of state policy making, making U.S. states ‘laboratories’ for RPS policy experimentation.

The renewable energy purchase obligations, for example, range from 2% to 30% of retail sales. Though wind, solar, landfill-gas, and geothermal energy are eligible under most of the policies, criteria for the eligibility of biomass and hydropower varies considerably across states. Some states allow sources such as energy efficiency and gas-fired fuel cells to qualify, although many would not consider these to be, strictly speaking, renewable. RPS obligations typically fall on investor-owned electric utilities and, where they exist, competitive energy service providers; the treatment of publicly-owned utilities varies, but exemptions are common.

Differences also exist with respect to the duration of the policies, whether additional technology bands exist to support solar power or other higher-cost resources, how out-of-state renewable generators are handled, whether existing renewable plants are eligible, what kind of enforcement is applied, what level of compliance flexibility is allowed, and the role of state funding. Most of the states have developed or are developing REC markets to ease compliance burdens, though the geographic scope of those markets as well as the definition of a REC varies; cross-market REC liquidity is therefore limited.¹⁰ Electronic REC tracking systems are now in place in Texas, New England, the PJM Interconnection and Wisconsin, and are being developed in the Midwest, West, and New York. Finally, many of the state RPS programs have various combinations and types of cost-caps, *force majeure* clauses, or other provisions for discretionary or non-discretionary regulatory waivers.

Table 2 illustrates a small subset of the important design differences that exist among existing state RPS programs.

¹⁰ It is worth mentioning that RECs may also be sold on a voluntary basis outside of RPS markets to meet the needs of the customer-driven green power market.

Table 2. State RPS Design Variations

State	Original Start Date	Current Ultimate Target	Existing Plants Eligible*	Technology Bands or Tiers
Arizona	2001	15% (2025)	No	Yes (Distributed Generation)
California	2003	20% (2010)	Yes	No
Colorado	2007	20% (2020)	Yes	Yes (Solar)
Connecticut	2000	10% (2010)	Yes	Yes (Class I/II Technologies)
Delaware	2007	10% (2019)	Yes	Yes (Vintage)
Hawaii	2005	20% (2020)	Yes	No
Iowa	1999	~2% (1999)	Yes	No
Maine	2000	30% (2000)	Yes	No
Maryland	2006	7.5% (2019)	Yes	Yes (Class I/II Technologies)
Massachusetts	2003	4% (2009)	No	No
Minnesota	2002	25-30% (2020-25)	Yes	Yes (Wind/Other for Xcel)
Montana	2008	15% (2015)	No	Yes (Community Wind)
Nevada	2001	20% (2015)	Yes	Yes (Solar)
New Jersey	2001	22.5% (2021)	Yes	Yes (Solar, Class I/II Technologies)
New Mexico	2006	20% (2020)	Yes	No
New York	2006	24% (2013)	Yes	Yes (Distributed Generation)
Pennsylvania	2001	8% (2020)	Yes	Yes (Solar)
Rhode Island	2007	16% (2020)	Yes	Yes (Vintage)
Texas	2002	~4.2% (2015)	Yes	Yes (Goal, Non-Wind)
Washington	2012	15% (2020)	No	No
Washington DC	2007	11% (2022)	Yes	Yes (Solar, Class I/II Technologies)
Wisconsin	2000	10% (2015)	Yes	No

* In some cases, RPS policies allow existing facilities built after a certain date, e.g., 1999. We list these states as not allowing existing resources in this table because they do not allow older existing facilities.

Source: Lawrence Berkeley National Laboratory

Importantly, while the number of states that have created RPS policies is large, experience with these policies remains somewhat limited; few of the states have more than five years of experience with their programs, and some of the policies have been established but have not yet taken effect. Not surprisingly, however, the diversity in policy design among states has already led to a range of experiences (and lessons learned) with the operations of an RPS.

Some programs appear to have stimulated significant renewable development, and at relatively low cost, while others have not. In some states, such as Texas, for example, RPS policies appear to have significantly contributed to new renewable energy additions. In other cases, including Massachusetts, Nevada, Arizona, New York, and California, it appears as if renewable energy deliveries are not currently on track to meet mandated targets for actual renewable generation.¹¹ And in still other cases – Maine being the most obvious example – RPS programs are largely supporting existing, not new, renewable generation.

As experience is gained with this policy instrument, some have noted concerns over policy implementation, including:

¹¹ This does not necessarily mean that the state's electricity utilities will be subject to penalties for lack of compliance, as cost caps, flexibility mechanisms, and *force majeure* clauses have so far excused most suppliers from being penalized.

- uncertainty in the duration or design of the policy;
- renewable energy targets and eligibility rules that in some cases do not require significant levels of new renewable energy development;
- unclear or inadequate enforcement of the policy;
- RPS obligations that may be too aggressive to be achieved in some instances;
- extensive exemptions from the purchase mandate;
- inadequate compliance flexibility;
- lack of sufficient standards for long-term contracting, and short-term REC markets that are too uncertain to support long-term financing;
- cost caps and *force majeure* clauses that are lenient enough to make full compliance unlikely; and
- lack of an adequate mechanism to proactively plan transmission to renewable resource rich areas.¹²

Many of these concerns center on the possibility that certain policy designs may weaken the RPS as a vehicle for promoting new renewable generation. However, concerns have also been expressed about the possibility of excess costs, the allocation of costs and risks, electricity reliability, and the possibility of other undesired or unintended outcomes. Clearly, RPS design is a complex process, and the details of that design are crucial to the ability of the policy to achieve the stated goals of encouraging increasing renewable energy supply.

B. Impacts on Renewable Energy Supply

State RPS policies are but one of a number of drivers for renewable energy capacity expansion. Other significant motivators include Federal and state tax incentives, state renewable energy funds, state integrated resource plans, voluntary green power markets, and the economic competitiveness of renewable energy relative to other generation options. Disentangling these various drivers is – to put it mildly – challenging. This task is further complicated by the fact that experience with state RPS policies remains somewhat limited.

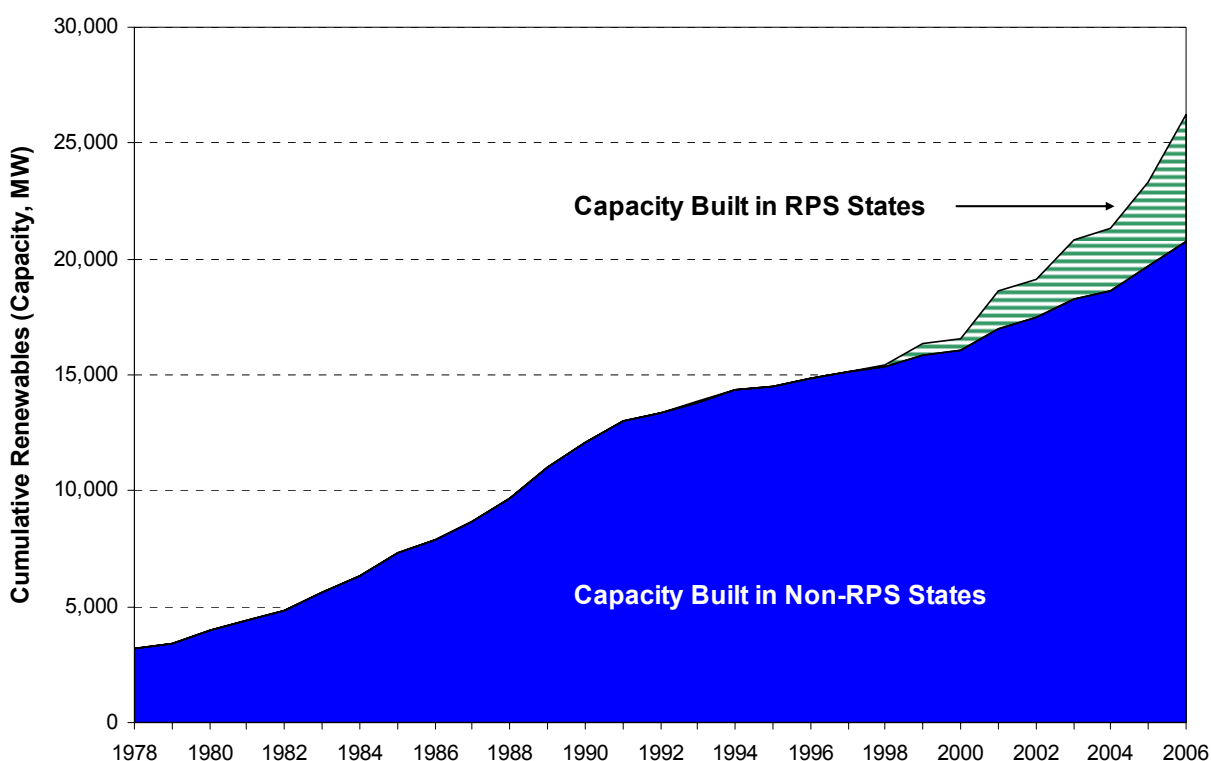
As shown in Figure 3, Black and Veatch estimates that roughly half of the new renewable capacity additions in the United States from the late 1990s through 2006 have occurred in states with RPS policies, totaling nearly 5,500 MW. Over 90% of these capacity additions have come from wind power, but biomass and geothermal have also played a role. Because of technology tiers that exist in a number of states (see Table 2), a growing amount of solar energy is also being buttressed by these obligations. The EIA, meanwhile, estimates that 7,300 MW of new renewable capacity was added to the 21 states with RPS obligations and purchase mandates, from each state's date of program enactment through the end of 2006.¹³

¹² See, e.g., (1) Wiser, Ryan, Kevin Porter, and Robert Grace. "Evaluating Experience with Renewables Portfolio Standards in the United States." LBNL-54439, March 2004. <http://eetd.lbl.gov/ea/ems/reports/54439.pdf>. (2) Rader, Nancy, and Scott Hempling. "The Renewables Portfolio Standard: A Practical Guide." Prepared for the National Association of Regulatory Utility Commissioners, February 2001.

¹³ This estimate excludes Washington, DC, which has an RPS policy, but minimal renewable generation capacity, and Washington state, which passed its RPS initiative at the end of 2006.

These estimates should be viewed with some caution. They track bulk non-hydro renewable energy capacity installations, without confirmation that any given facility was constructed *because of* a state RPS or was, in fact, even eligible for a given state's RPS. Further complicating the estimation is that some states allow out-of-state generation to count toward their RPS requirements, so renewable capacity built in a non-RPS state may be used to meet another state's mandate. In fact, significant renewable installations have occurred in states without RPS programs.

One cannot therefore claim that all of this capacity was uniquely and solely motivated by state RPS programs – federal tax policy has played a particularly important role. Research at Berkeley Lab, however, suggest that, between 2001 and 2006, over 50% of the total wind additions in the U.S. were motivated, at least in part, by these state RPS policies. Furthermore, Menz et al. have shown a statistical relationship between state RPS policies and wind power development.¹⁴



Source: Black and Veatch

Figure 3. Cumulative Non-Hydro Renewable Energy Capacity in the United States

Many analysts expect these impacts to expand over time, though the magnitude of that growth depends on whether the RPS policies are implemented fully, whether cost caps are limiting, and whether new renewable energy projects would have come on line absent the support of state RPS policies. Because of these complexities, a wide range of impact estimates has been offered.

¹⁴ Menz, Fredric, and Stephan Vachon. "The Effectiveness of Different Policy Regimes for Promoting Wind Power: Experiences from the States." *Energy Policy*, 34, 2006.

The Union of Concerned Scientists (UCS), for example, has estimated that roughly 45 GW of new renewable energy capacity may be needed by 2020 to fully meet the existing state RPS policies. Global Energy Advisors sees upwards of 52 GW required by 2020 to meet these mandates.¹⁵

In contrast, the National Renewable Energy Laboratory (NREL) has estimated that existing state policies, including most prominently state RPS programs, could result in just 8 – 12 GW of new wind capacity relative to a no-state-policy base case.¹⁶ These lower capacity estimates are a reflection of two important factors in the NREL analysis: (1) an assumption that significant renewable energy capacity additions would occur even absent state RPS policies, and (2) an assumption that cost caps will limit the impacts of some of the state RPS policies.

Using an approach somewhat similar to that used by NREL, the EIA estimates that some regions with existing state RPS programs could see substantially more renewable electricity generation than is projected in the *AEO2007* reference case.¹⁷ State standards in the Mid-Atlantic and New England regions could result in approximately 350% and 20% more renewable generation by 2030, respectively, than projected in the reference case. Though the total increase in renewable generation in New York is expected to be just over 10% by 2030, generation from non-hydro renewable resources would nearly double compared to the reference case. In other regions, the impact of the standards is projected by the EIA to be less pronounced, as these regions have either already largely met their renewable electricity requirements with existing and planned capacity or are projected to build sufficient renewable capacity based on economic merits alone even without an RPS policy. In aggregate, the EIA estimates that existing state RPS policies could result in over 30% more electricity generation from non-hydropower renewables in 2030 than is projected in the *AEO2007* reference case, with new installed renewable capacity of almost 20,000 MW relative to 2006 capacity, or about 10,000 MW more than the reference case.

Though the market impacts of existing state RPS policies is somewhat uncertain, there is little doubt that the aggregate amount of new renewable energy generation required under these policies is significant, at least when compared to recent industry growth. That said, even taking one of the higher estimates provided by UCS, the amount of additional renewable energy generation required under existing state RPS programs equates to just 3% of total 2020 electric sales in the U.S., roughly doubling the percentage of non-hydro renewable energy generation currently serving the nation. In this scenario, 16% of the roughly 900 TWh of demand growth expected by EIA from 2006 to 2020 would come from new renewable generation required under existing state RPS policies.

¹⁵ Knutson, Kent, and Peter McMahan. "Closing the Green Gap." *Public Utilities Fortnightly*, April 2005.

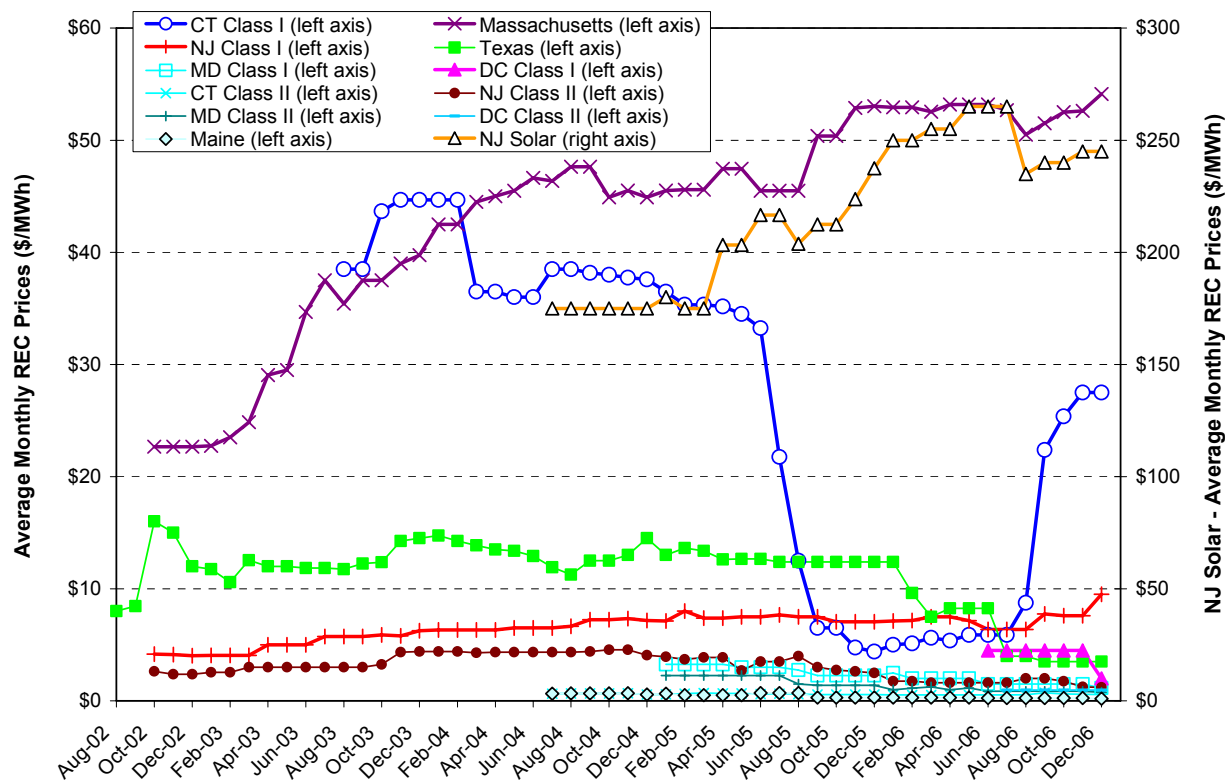
¹⁶ Blair, Nate, Walter Short, Paul Denholm, and Donna Heimiller. "Long-Term National Impacts of State-Level Policies." NREL-CP-620-40105, June 2006. <http://www.nrel.gov/docs/fy06osti/40105.pdf>.

¹⁷ See the EIA's Annual Energy Outlook (AEO) 2007, page 28. http://www.eia.doe.gov/oiaf/aeo/pdf/leg_reg.pdf. In this analysis, states are aggregated into electricity market regions, approximately corresponding to regions of the North American Electricity Reliability Council.

C. Cost Impacts

State RPS policies could have substantial impacts on electricity markets, ratepayers, and local economies. Unfortunately, the actual costs (and benefits) of state RPS policies have not been compiled in a comprehensive fashion, in part because of the early state of policy implementation and in part because of methodological complexities and data availability constraints. Nonetheless, it is reasonably clear that, to date at least, cost impacts of state RPS policies have varied substantially by state but, at the same time, there is little evidence of a sizable impact on average retail electricity rates in most instances.

Figure 4 presents historical REC prices for those states in which RECs trade is sufficiently liquid to result in reasonably transparent transaction data. These states are typically those in which both retail electric competition and liquid wholesale electricity markets exist. Though not a comprehensive picture of all states, the figure clearly indicates that spot REC prices have varied substantially across regions and resource types, and that significant price fluctuations are possible even within a particular state over time.



Source: Berkeley Lab compilation of data from Evolution Markets¹⁸

Figure 4. Compliance REC prices in the USA 2002-2006

¹⁸ The source of these data is Evolution Markets' monthly REC pricing reports, as compiled by Berkeley Lab.

Some of this price variation can be explained by RPS design: the Maine and “Class II” requirements can be met entirely with existing renewable generation, suppressing REC prices, for example, while New Jersey’s solar RECs are costly due to the underlying cost of solar electricity. In other cases, the high price of RECs is caused by annual RPS-driven demand exceeding currently available renewables supply (e.g., Massachusetts). Variations in REC prices across time are caused by many factors, including unpredicted policy changes affecting renewable energy supply and demand conditions (e.g., in Connecticut, policies have changed on the extent to which existing biomass generators are eligible under the RPS, creating significant REC price fluctuations). Weiss and others have suggested that widely fluctuating REC prices may be an inherent feature of RPS markets, resulting from a largely fixed demand for renewable energy (as established by the RPS) and limited short-term renewable energy supply flexibility.¹⁹ Whatever the cause, these fluctuating prices have, in some cases, impeded renewable energy development because they offer unclear price signals to renewable energy investors about the attractiveness of development activity. In fact, RPS policies appear to have experienced more renewable project development when applied in markets that still attract long-term power purchase agreements and therefore also long-term investment and financing.²⁰

Translating these REC prices, as well as the renewable electricity contracts that predominate in most other states not shown in Figure 4, into retail rate impacts is challenging. Nonetheless, if one assumes that REC prices represent the incremental above-market cost of renewable energy, that the prices presented in Figure 4 are representative of all RECs used for RPS compliance, and that certain state-specific cost caps are binding, then these data translate into RPS-induced retail rate impacts in 2006 of: Maine (0.1%), Maryland (0.1%), New Jersey (0.1%), New York (0.1%), Connecticut (0.2%), Arizona (0.4%), and Massachusetts (1.1%). These retail rate impacts will grow as RPS percentage obligations increase, unless REC prices simultaneously decline.

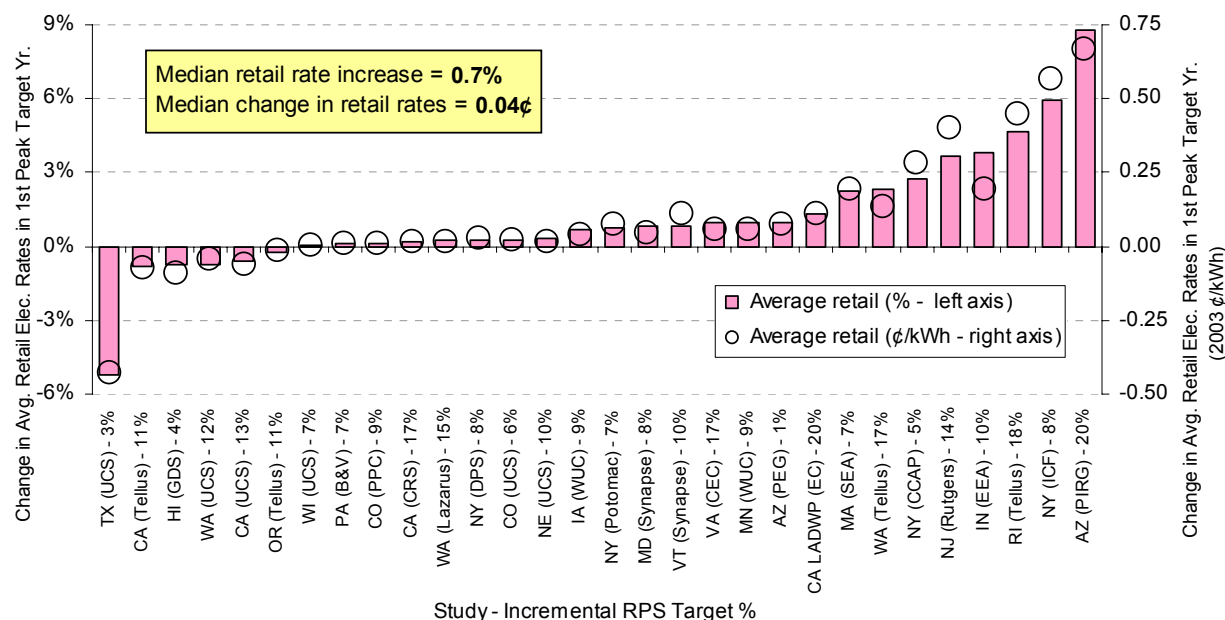
In states where long-term renewable electricity contracts (not short-term trade in RECs) predominate as the mode of state RPS compliance, retail rate impacts are more difficult to estimate due to the confidentiality of contract terms and the challenges of associating transmission and integration costs to individual renewable energy purchases. Nevertheless, the vast majority of new renewable energy contracts that have been inked in California since 2002 (2,000 MW of the 2,140 MW of contracts that have been signed) have been signed at prices that are below the state’s market price referent – the calculated cost of new gas-fired generators. Anecdotal evidence suggests low renewable energy prices in New Mexico, Colorado, Minnesota, Texas, Montana, and Wisconsin as well. In these instances, it is not clear whether state RPS policies are leading to higher, or lower, retail electricity prices, but lower prices are certainly possible. That is, higher renewable technology costs may be offset by lower fuel and operations and maintenance (O&M) costs. More analysis of these impacts is warranted.

Another approach to estimating cost impacts is to review state RPS cost-impact *projections*. Though these are projections, and therefore embody numerous assumptions that will not be universally agreed upon, they may be useful in understanding potential long-term impacts,

¹⁹ Weiss, Jurgen. “Are REC Markets a WRECK Waiting to Happen?” NREL Energy Analysis Seminar. February 8, 2007. http://www.nrel.gov/analysis/seminar/pdfs/2007/ea_seminar_feb_8_p.pdf.

²⁰ See, e.g., Wiser, Ryan, Kevin Porter, and Robert Grace. “Evaluating Experience with Renewables Portfolio Standards in the United States.” LBNL-54439, March 2004. <http://eetd.lbl.gov/ea/ems/reports/54439.pdf>.

especially given the rising levels of renewable energy required by state RPS policies over time. Based on a review of 28 such studies, covering 18 states (not all of which have actually implemented a state RPS), Berkeley Lab has recently found that projected rate impacts are generally reasonably modest, but can be significant in some instances (see Figure 5).²¹ In particular, 70% of the state RPS cost studies in the Berkeley Lab sample forecast retail electricity rate increases of no greater than 1% in the year that each modeled RPS policy reaches its peak percentage target. In six of these studies, state electricity consumers are projected to experience cost savings as a result of the RPS policies being modeled. On the other extreme, nine studies predict rate increases above 1%, and two of these studies predict rate increases of more than 5%.



Source: Lawrence Berkeley National Laboratory

Figure 5. Projected RPS Electricity Rate Impacts by Cost Study

The EIA has also investigated the possible impacts of existing state RPS programs, on a regional basis. EIA projects modest electricity price impacts, both regionally and nationally; generally less than plus or minus 1%, relative to a no-state-RPS reference case, in a given year or region.²² Whether the benefits of an RPS exceed these projected costs is subject to debate.

²¹ Chen, Cliff, Ryan Wiser, and Mark Bolinger. "Weighing the Costs and Benefits of Renewables Portfolio Standards: A Comparative Analysis of State-Level Policy Impact Projections." Lawrence Berkeley National Laboratory, LBNL-61580, March 2007.

²² EIA Annual Energy Outlook 2007. http://www.eia.doe.gov/oiaf/aeo/pdf/leg_reg.pdf.

V. Federal RPS Proposals

A. Federal Design Issues

Congress has considered a number of Federal RPS proposals (and amendments) in the U.S. House of Representatives and the U.S. Senate. To date, no proposal has been passed by both houses. The EIA has analyzed several of these proposals, including legislation sponsored by Senator Jeffords (10% RPS)²³ and Senator Bingaman (10% RPS)²⁴ prior to the current legislative session, and by Senator Coleman (20% “clean energy” portfolio standard) in the current session.²⁵ Bingaman’s original proposal, S.517, was introduced in March 2001 and was passed by the Senate in April 2002, and was substantially similar to a proposal, also from Senator Bingaman, which passed the Senate in 2005.

All of the Federal RPS proposals have certain common design features, including: a renewable production target and schedule; a range of qualifying technologies; tradable credits; credit price caps; exemptions for certain classes of retail electricity suppliers; and (except for the Coleman proposal) sunset provisions. These provisions largely mirror policy devices found in one or more of the state RPS programs. Significantly, the Federal programs would all allow tradability of RECs within the entire U.S., whereas most state policies contain significant state-wide or regional limitations on REC sources. The Federal proposals have also tended to assume a replacement of the Federal Production Tax Credit (PTC) with a National RPS, whereas state programs will operate with or without the Federal PTC.

Though the various proposals have had common design elements, the specifics vary significantly. For example, in the Coleman proposal, the qualifying technologies include nuclear power and fossil-fired plants that capture and sequester carbon dioxide emissions. In the original Bingaman proposal, existing hydropower would not count toward meeting the requirement, but would reduce a retail supplier’s renewable energy purchase obligation (by reducing the retail sales on which the RPS target applies). The Coleman proposal has a 20% target, but electricity providers are never required to hold RECs in excess of total sales growth from a baseline period. A variety of other differences also exist among these proposed Federal RPS policies.

B. Federal and State RPS Interactions

As policymakers discuss the merits and design of Federal RPS proposals, one design element that will need to be addressed is how such a *Federal* standard might interact with the pre-existing *state* RPS policies. The Bingaman proposal in the 109th Congress contained provisions indicating that the Federal RPS would not pre-empt state RPS programs, and should coordinate

²³ See “Impacts of a 10-Percent Renewable Portfolio Standard” at [http://www.eia.doe.gov/oiaf/servicerpt/rps/pdf/sroiaf\(2002\)03.pdf](http://www.eia.doe.gov/oiaf/servicerpt/rps/pdf/sroiaf(2002)03.pdf).

²⁴ See “Analysis of a 10 Percent Renewable Portfolio Standard” at <http://www.eia.doe.gov/oiaf/servicerpt/rps2/index.html>, also bill H.R. 6, engrossed amendments as agreed to by the Senate (109th Congress) at <http://thomas.loc.gov>.

²⁵ See “Energy Market Impacts of a Clean Energy Portfolio Standard” at <http://www.eia.doe.gov/oiaf/servicerpt/emice/index.html>. Note that this proposal includes nuclear and coal with sequestration as well as renewable energy, so it may or may not strictly fall under the classification of an “RPS”, but it otherwise shares common RPS features. Several state RPS programs include non-renewable resources as well.

to the extent practicable with such programs.²⁶ These provisions, however, did not explicitly address issues such as whether generation applied to a state target may also be applied to the Federal requirement, or if financial compliance mechanisms (alternative compliance payments, penalty payments, and so forth) at the state level are acceptable for Federal compliance.²⁷ Presumably, such issues could be addressed by regulation at the Federal level, based on the coordination direction in the proposal, but there is no specific guidance on such issues. The more recent Coleman proposal, on the other hand, explicitly allows qualified state credits to count towards the Federal requirement. It also has provisions allowing limited trade of excess state credits²⁸ and allowing state financial compliance mechanisms to count towards the Federal requirement.

These issues have not been addressed clearly in most state-level RPS policies. Most states specifically address “double-counting” of credits, generally to disallow the same credits or generation from being used to satisfy more than one RPS requirement. In many states, double-counting restrictions are specified against another *state*’s program, but several states prohibit the practice with respect to any other *jurisdiction*. Whether these restrictions are intended to disallow an electricity provider from using its state RPS purchases towards a possible future Federal RPS is unclear. In fact, it appears as if only Colorado has specifically addressed Federal RPS interactions, by allowing credits to count against both the Colorado target and any prospective Federal requirement. Clearly, interactions between state RPS policies and a possible Federal RPS are one of the complicating features that must be addressed as Federal RPS policies are proposed, and as state policies develop.²⁹

VI. Conclusions

The popularity of state RPS policies has grown. With twenty-two RPS policies now in existence in the U.S., covering 40% of the nation’s electrical load, the importance of these programs is expected to build over the coming decade.

State RPS policies can and are designed in a variety of ways, and state RPS implementation experience in the U.S. has been mixed. Comparative experience from states that have and have not achieved substantial renewable generation growth highlight the importance of design details in achieving stated policy objectives. Policy advocates and policy makers might consider this state experience as debates over the possibility and design of a Federal RPS continue.

²⁶ For example, see “Analysis of a 10 Percent Renewable Portfolio Standard” at <http://www.eia.doe.gov/oiaf/servicerpt/rps2/index.html>, also bill H.R. 6, engrossed amendments as agreed to by the Senate (109th Congress) at <http://thomas.loc.gov>

²⁷ Payments for not meeting state targets in excess of the Federal requirement would be allowed to count against any Federal compliance payments.

²⁸ That is, in a state where the renewable share requirement exceeds the Federal share requirement, a company may assign “excess” credits to an affiliate in another state.

²⁹ In the event that the Federal government passed an RPS with explicit language addressing the double-counting issue, there is always the possibility that state RPS statutes, as they affect Federal jurisdictions, would be rendered moot on constitutional grounds.